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EXAMINER

KIELIN, ERIK J

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 09/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

08/636,069

Applicant(s)

SANDHU ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 31, 33-36 and 38-54 is/are pending in the application.
- 4a) Of the above claim(s) none is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 31, 33-36 and 38-54 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 April 1996 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This action respond to the Amendment filed 30 June 2003.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1, 2, 4-6, 31, 33-36, and 38-54 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Each independent claim, 1, 31, 42, 43, 45-48, and 50-53, recites the limitation that the reaction volume of gases located above the substrate within a chemically reactive distance of the substrate is exposed to a light source "without directly exposing the substrate to the light source." The specification, however, states, that it is not necessary "to illuminate the substrate surface" (p. 7, lines 21-26). As presently written, the amendments to each independent claim, still includes indirectly exposing the substrate such as by reflection off of a mirror or a diffraction grating which is *not* supported by the specification. The specification, on the other hand, only supports not illuminating the substrate surface, which *excludes* indirect exposure of the substrate to the light source. Accordingly, the claims as presently written are not supported by the specification because the amended claim language is not in the specification and furthermore has no basis from the specification for any indirect, or not directly, exposing the substrate to the light source.

3. Claims 45 and 50 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. Ozone or some oxygen source, critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Each of claims 45 and 50 deposit a silicon oxide layer, and require illumination to increase the functional atomic oxygen concentration, yet no oxygen source has been provided in the claim. The specification indicates that this source is ozone. This feature is critical because the functional atomic oxygen concentration cannot be increased if there is no oxygen source present. Moreover, silicon dioxide --an oxygen-containing material-- cannot be deposited in the absence of an oxygen source.

4. Claims 1, 2, 4-6, 31, 33-36, and 38-54 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a pressure on the order of 0.01 atmosphere (7.6 Torr), does not reasonably provide enablement for a pressure range of 200 to 760 Torr. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Each independent claim, 1, 31, 42, 43, 45-48, and 50-53, recites the limitation that the pressure range is between 200 Torr and 760 Torr. However, the claims require that only the reaction volume is illuminated without illuminating the substrate and that heterogeneous reactions must take place in the reaction volume as opposed to homogeneous reactions. As will be explained below, the specification has not enabled how one of ordinary skill could illuminate

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only the reaction volume in the pressure range of 200 Torr to 760 Torr while also maintaining only heterogeneous reactions.

US 4,579,750 (Bowen et al.) teaches that in order to reduce the probability of homogeneous reactions and enhance the probability of heterogeneous reactions, the illuminated region must be focus above the substrate and must be absorbed by the reactive gas molecules "within a few mean free path lengths of the gaseous molecules" of the substrate surface. (See Bowen, col. 3, lines 19-43 -- especially lines 32-35.) According to the teaching in Bowen, then, in order only to reduce the probability of homogenous reactions from occurring in the reaction volume, the illuminated region (i.e. the reaction volume) must be only a few mean free path lengths thick.

The mean free path of a gas molecule is defined as the distance between collisions with other gas molecules or a surface and is given by the equation

$$\lambda = 5 \cdot 10^{-3} / P$$

where λ is the mean free path in cm (centimeters) and P is the pressure in Torr. (Ohring, The Material Science of Thin Films, Academic Press: Boston, 1992, p. 53.) Given Applicant's presently claimed pressure range of 200 Torr to 760 Torr in each independent claim, the mean free path length is from 0.065 μm to 0.24 μm (65 nm to 240 nm); therefore, the thickness of the illuminated region must be at most about 0.72 μm (720 nm) or 3 times 0.24 μm in order to reduce the probability of homogeneous reactions.

Applicant indicates that an array of lamps, or specifically mercury arc vapor lamps (specification, p. 7, lines 21-29), are used to provide the illumination. Mercury arc vapor lamps emit, *inter alia*, UV wavelengths of 253 nm, 296 nm, and 365 nm (US 3,866,083 Datta et al.; col.

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1, lines 10-16)--which is on the order of the thickness of the reaction volume required to reduce the probability of homogeneous reactions. Accordingly, the light from the mercury arc vapor lamp must be reshaped somehow into a beam thickness on the order of the wavelength of the light being emitted. However, any attempt to reduce the thickness of the incoherent light emitted from lamp down to the order of the wavelength of light emitted (by a slit or focusing lens on the order of the wavelength) will necessarily result in diffraction or "spreading out" of the light beam. (See Harrison, The Cassell Dictionary of Physics, Cassell: London, 1988, pp. 44-45--especially the section entitled "diffraction.") This then would necessarily result in the light source illuminating the substrate -- contrary to the requirement in the claims.

By contrast, Bowen teaches that a lower pressure, on the order of 7.6 Torr ($\lambda = 6.5 \mu\text{m}$ or 6500 nm, several times thicker than that λ at 200 Torr to 760 Torr), is necessary to reduce the probability of homogeneous reactions (Bowen, col. 9, lines 22-36), and also uses a laser -- a coherent light source-- to attain illumination of only the thin reaction volume above the surface of the substrate.

According to the evidence of record, illumination of only the reaction volume without also illuminating the substrate surface at a pressure of 200 Torr to 760 Torr using while maintaining only heterogeneous reactions cannot happen. For this reason, the claims are not enabled. Note that the specification states that 1.0 Torr to 760 Torr are pressures that can be used (p. 7, lines 3 and 4). A coherent light source such as a laser and a pressure of less than about 7.6 Torr, as taught by Bowen, would work. The specification does not provide for use of a coherent light source.

The remaining claims are rejected for depending from the independent claims.

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5. Claims 1, 2, 4-6, 31, 33-36, and 38-54 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The claims do not have support for “without directly exposing the substrate to the light source.” As indicated in the specification and admitted to by Applicant in Applicant’s most recent response (Paper no. 40) to the most recent Office action (Paper no. 39), the specification states only, that “[it] is **not necessary** to illuminate the gas volume in the rest of the CVD chamber or **to illuminate the substrate.**” (Emphasis added.) This is the only mention in the entire disclosure regarding not illuminating the substrate. Of particular importance is that Applicant has already argued that the substrate is not illuminated (Paper no. 12, pp. 12-14) in order to overcome the prior art of **Hisamune**. It is contrary to that which Applicant has already argued to now state that “without directly exposing the substrate to the light source” means that the substrate may still be illuminated, as argued on page 16 of the most recent response (Paper No. 40, p. 16, first full paragraph.) Otherwise there would be no reason to have removed several of the previous prior art rejections, which will be re-introduced should Applicant insist that illumination of the substrate is somehow including in the limitation “without directly exposing the substrate to the light source.”

Drawings

6. The disclosure is objected to under 37 CFR 1.81(a) and 37 CFR 1.83(a), as failing to have drawings necessary to understand the invention. Drawings are necessary to understand the following: The apparatus by which the silicon dioxide is formed --especially wherein illumination of only the reaction volume, but not the substrate, while maintaining only heterogeneous reactions and not homogeneous reactions, in a pressure in the range of 200 Torr to 760 Torr. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims **31**, **33**, **34**, **38-40**, **42**, **51**, and **52**, are rejected under 35 U.S.C. 103(a) as being unpatentable over US 4,581,248 (**Roche**) in view of JP 02-050966 (**Hisamune**), and considered with US 4,579,750 (**Bowen et al.**) for a showing of inherency.

Regarding independent claims **31**, **42**, **51**, and **52**, **Roche** discloses a method of depositing a silicon dioxide layer on a substrate surface comprising,

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heating a substrate **22** to a temperature of about 20 °C to 600 °C, with specific examples at 450 °C and 500 °C (col. 7, lines 1-3 and Table I) which overlaps 480 °C to 700 °C;

contacting the substrate **22** with a reaction volume **25** of gas located above the substrate surface within a chemically reactive distance of the substrate (col. 2, lines 17-32; col. 3, lines 35-45; col. 7, lines 64-65), the reaction volume of gas comprising an SiO₂ precursor and an oxygen source -- namely N₂O in a carrier gas of nitrogen --as further limited by instant claims 33 and 34, (col. 3, lines 53-62; col. 4, line 66 to col. 5, line 38);

illuminating the reaction volume of gas **25** from a high intensity light source -- specifically an ArF laser (col. 5, line 2), without illuminating the substrate (col. 2, lines 17-32) to increase the functional oxygen concentration (col. 5, lines 34-39); and

subjecting the reaction volume of gas to about 8 Torr during the deposition (col. 5, lines 43-48).

The limitation that the fixed charge in the deposited film is reduced is also inherently met because Applicant's specification specifically states that it is the atomic oxygen reduces fixed charge. (See instant specification, paragraph bridging pages 7 and 8.)

The limitation that the reactant gases in the reaction volume undergo heterogeneous reactions rather than homogeneous reactions is met because **Roche** indicates that reactant species are only formed where the laser light is provided (i.e. the region **25**; Roche, col. 7, lines 64-65) and because **Bowen** --who teaches the same photo CVD method as **Roche**-- indicates that irradiating the only region just above the substrate and keeping the pressure around 0.01 atm (7.6 Torr) will reduce the probability of homogeneous reactions in the reaction volume and promote

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heterogeneous reactions (i.e. reactions between the reactant gases and the substrate surface). (See Bowen, col. 3, lines 20-43.)

Further in this regard, the limitation “the reactant gases in the reaction volume taking part in heterogeneous chemical reactions, rather than homogeneous reactions taking place in the gas volume in the chamber outside the reaction volume” is also necessarily met because Applicant has defined the reaction volume by the existence of the presence of heterogeneous reactions and the absence of homogeneous reactions. The specification merely *defines* such homogeneous reactions as those which occur outside “the reaction volume,” but does not limit homogeneous reactions from taking place. (See instant specification, p. 7 --especially lines 15-20.)

Roche does not teach a pressure in the range of 200 Torr to 760 Torr or more specifically about 200 Torr --as further limited by instant claim 38. If it is thought that these pressures are somehow enabled, then this may be a difference. However, it has been held that “claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art.” See *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996). In this case, Applicant’s specification, as noted above, teaches that the pressure range in which the instant invention works is 1.0 Torr to 760 Torr. Accordingly, the specification does not provide evidence of a new and unexpected result for the pressure of 200 Torr or the range of from 200 Torr to 760 Torr, as per the required precedent.

Further regarding the independent claims 31, 42, 51, 52, and claim 39, **Roche** does not teach using ozone as the oxygen source or TEOS as the SiO₂ precursor.

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Hisamune teaches a photo-assisted CVD method wherein the TEOS and ozone are used to deposit a SiO₂ film and wherein UV light is used in conjunction with the oxygen source to increase the functional oxygen concentration. (See Hisamune translation pp. 4-7.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use ozone and TEOS as the precursors in **Roche**, as taught by **Hisamune**, because one of ordinary skill would recognize that ozone and TEOS work just as well for forming a silicon dioxide film by photo CVD, as taught by **Hisamune**. In this regard, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 65 USPQ at 301.). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960) ("Mere selection of known plastics to make container-dispenser of a type made of plastics prior to the invention, the selection of the plastics being on the basis of suitability for the intended use,

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would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.”) (See MPEP 2144.07.)

Then regarding claims 40 and further regarding independent claims 42 and 52, while **Roche** does not teach a dopant, **Hisamune** teaches the use of trimethylphosphite as the dopant source to form phosphorus-doped SiO₂. (See Hisamune p. 2, p. 6, and p. 7, the sentence before Table 1.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add phosphorous dopant, as taught by **Hisamune**, to the SiO₂ film of **Roche**, in order to form a phosphorous-doped silicate glass which is desired in the semiconductor fabrication art, as taught by **Hisamune**, which is known to getter contaminant ions such as sodium and moisture and also to reduce the reflow temperature of the glass.

Then further regarding independent claims 51 and 52, **Roche** does not teach the use of a mercury arc vapor lamp. If it is believed that use of this light source is enabled for the pressure range of 200 Torr to 760 Torr, then this may be a difference. **Hisamune** teaches the use of a mercury vapor lamp to illuminate the reaction gas mixture.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use a mercury vapor lamp, as the light source of **Roche**, as long as it could illuminate the region just above the substrate, because each of **Roche** and **Hisamune** use an ultraviolet light source to provide an increase in atomic oxygen (Roche, col. 5, lines 2-20 and 34-39; Hisamune, Table 1), such that a mercury arc vapor lamp would be expected to work just as the Roche UV laser, since both produce the required UV light.

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9. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, as applied to claim 31 above, and further in view of US 5,112,647 (**Takabayashi**).

Regarding claim 35, the prior art of **Roche** in view of **Hisamune**, as explained above, discloses each of the claimed features except for specifying that helium may be the carrier gas.

Takabayashi teaches a photo CVD method wherein the light is provided just over the surface of the substrate without directly illuminating the substrate and uses He as the carrier gas (col. 5, lines 51-67).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use helium as the carrier gas of **Roche** in view of **Hisamune** because **Roche** uses a carrier gas, and **Takabayashi** teaches the helium is a known carrier gas for photo CVD, such that one of ordinary skill would recognize that helium, being inert would work just as well as another inert gas. Moreover, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious, as noted above.

10. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, as applied to claim 31 above, and further in view of US 5,605,867 (**Sato et al.**).

The prior art of **Roche** in view of **Hisamune**, as explained above, discloses each of the claimed features except for specifying the amount of ozone used in the deposition of the SiO₂ film.

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Sato teaches a photo CVD method (paragraph bridging cols. 37-38) for depositing SiO₂ for semiconductor fabrication, using TEOS and O₃. **Sato** also teaches that the ozone can be varied over a wide range and teaches that 5% is an exemplary amount (col. 10, lines 13-21).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use 5% ozone in the reactant gas mixture, as taught by **Sato**, in the deposition method of **Roche** in view of **Hisamune**, because **Hisamune** is silent to the amount of ozone, such that one of ordinary skill would necessarily have to determine how much to add, and **Sato** teaches that Moreover, this claims is *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

11. Claims 1, 2, 4-6, 41, 43, 44, 45, 46, 47, 48, 49, 50, 53, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, and further in view of EP 0 562 625 A2 (**Imai et al.**).

The prior art of **Roche** in view of **Hisamune** as explained above, discloses each of the claimed features, except for using at least two dopant sources (instant claims 43 and 53), specifically boron and phosphorous dopants as the two dopant sources (instant claims 1, 44, and

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54), the specific dopant sources for boron (instant claims 4, 6, 41, 45), fluorine dopant in the SiO₂ (instant claims 46), fluorine and one dopant source (instant claim 47), fluorine and two additional dopant sources (instant claim 48), fluorine with boron and phosphorous as the two additional dopants (instant claim 49), the specific boron and fluorine sources (instant claim 50).

Imai teaches the benefits of forming a fluorine-doped BPSG (FBPSG) film to reduce the reflow temperature below that of BPSG alone. (See Abstract.) The FBPSG film is produced by a CVD method wherein ozone, TEB, TMOP, and FTES are used to form the FBPSG layer. (See section entitled "FIRST EMBODIMENT" beginning on p. 6.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add boron, phosphorous, and fluorine, as taught by **Imai**, to the SiO₂ layer of **Roche**, or to add boron and fluorine to the phosphorous-doped SiO₂ of **Roche** in view of **Hisamune**, to reduce the reflow temperature of the SiO₂ layer, as taught to be beneficial in **Imai**.

Response to Arguments

6. Applicant's arguments filed 30 June 2003 (Paper No. 40) have been fully considered but they are not persuasive.

Beginning on p. 13, Applicant argues that the Office action is "mistaken" in indicating that the claims 1, 2, 4-6, 31, 33-36, and 38-54 are enabled. Examiner respectfully disagrees for reasons indicated in the rejection under 35 USC 112(1) above.

In the regard, Applicant argues that illumination of the substrate is indicated in the specification. However, this is not the basis of the rejection. As presently written, the claims indicate that the substrate **cannot be illuminated**. To argue that the claims are somehow enabled

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based upon that which is specifically excluded by the claim language --specifically the limitation “without directly exposing the substrate to the light source”-- is illogical.

Next, Applicant argues that the specification at p. 7, lines 15-17, indicates that “some of the ‘reaction volume’ is impliedly exposed to optical excitation, but is not located with a chemically reactive distance of the substrate.” Examiner respectfully but emphatically disagrees. The specification makes no such implication and, in fact, contradicts this implication that a portion of the reaction volume undergoes “homogeneous reactions.” The specification states on p. 7, lines 15-20,

“The **reaction volume** of gases that is exposed to optical excitation in this process is **meant to describe** the volume of **gas located within a chemically reactive distance of the substrate**. The gas volume located in this vicinity is sometimes described in terms of the type of chemical reaction it tends to undergo. The reactant gases in the reaction volume are referred to as taking part in heterogeneous chemical reactions, **rather than homogenous reactions that take place in the gas volume in the rest of the chamber**.” (Emphasis added.)

Accordingly, the **specification specifically excludes homogeneous reactions from the reaction volume**. It is therefore, contradictory for Applicant to argue that the specification “impliedly” includes that some of the gas molecules in the reaction volume will undergo homogeneous reactions. Examiner notes with interest that Applicant excluded the rest of the paragraph from which Applicant quoted when it clearly contradicts Applicant's position in this regard.

For these reasons, the claims 1, 2, 4-6, 31, 33-36, and 38-54 under 35 USC 112(1), stand rejected.

Applicant argues, on p. 14 of the Amendment (Paper no. 40), that claims 45 and 50 are enabled. Examiner respectfully disagrees. Applicant fails to address the precedent in *In re*

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Mayhew that features critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). The instant specification has indicates that the purpose of the light source is to increase the amount of active oxygen in the reaction volume (specification, paragraph bridging pp. 7-8), such cannot happen if there is no ozone source is present. Accordingly, the claims 45 and 50 stand rejected.

On pp. 14 to 16 of the Amendment (Paper no. 40), Applicant argues that the Office is “mistaken” that claims 1, 2, 4-6, 31, 33-36, and 38-45 are not enabled for the pressure range of 200 to 760 Torr. Examiner respectfully disagrees for reasons indicated in the rejection of the claims, as noted above and included herein in their entirety.

In this regard, Applicant argues, “The Office Action goes far afield into a theory that is based upon a fundamentally incorrect first principles.” Applicant is mistaken. The first principles are correct. The relation in Ohring is quite applicable to the reaction volume of the instant invention. The relation in Ohring, even though for air, is a **best-case** scenario for the mean free path of the reaction volume of the instant invention. In other words, the mean free path will only be **shorter** in the instant invention and therefore require the illumination source to be able to illuminate an even more narrow reaction volume than that predicted by the air model. Why? Because the **mean free path is inversely related to the size of the molecule**. The presently disclosed reactive gas molecules are much larger that those in ambient air. In other words, organosilicon, organophosphorous, and organoboron compounds have many more atoms and are therefore much larger than diatomic oxygen and nitrogen and monatomic argon that make up 99% of air. Analogously, the collisional cross-section of a bowling ball (i.e. the organosilicon,

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organophosphorous, and organoboron compounds) is much larger than that of a marble (i.e. oxygen or nitrogen or argon). Accordingly, the mean free path for 100 organosilicon molecules is necessarily shorter than that 100 "air" molecules at any given pressure. (For verification, see pp. 616-620--especially p. 617, the starred paragraph, of the basic, high school chemistry textbook, Atkins and Jones, Chemical Principles, W. H. Freeman and Co.: New York, 1999. Accordingly, Examiner has applied no "fundamentally incorrect first principles."

Further in this regard, Applicant asserts that temperature should be in the equation. Examiner respectfully disagrees. The temperature has no impact whatever on the mean free path. The mean free path, as the equation correctly points out is related to the number of molecules and the space between them. The temperature cannot change these for a fixed volume system. As pointed out in Chemical Principles, however, the temperature affects the collision **rate** --**not** the distance traveled between collisions (i.e. the mean free path).

Applicant further argues on p. 15, "The Office action has made no assertion regarding the exact relationship between mean free path lengths of reactant molecules and the wavelength of a given light." Examiner respectfully disagrees. This relation is given in US 4,579,750 (Bowen et al.), as stated above in the rejection of the claims and incorporated herein in its entirety. Moreover, Applicant is kindly requested to provide evidence, rather than speculation, that the temperature somehow affects the size of the molecules and the space between them, such that the mean free path is significantly altered from that given by Ohring. It is noted that MPEP 2145 states that "argument does not replace evidence where evidence is necessary." Applicant speculates that temperature would affect mean free path without evidence.

In final regard to the rejections under 35 USC 112(1), as to scope of enablement, Applicant argues,

“Applicant again directs the Office to the Specification at page 7, wherein it states, ‘[it] is **not necessary** to illuminate the gas volume in the rest of the CVD chamber or **to illuminate the substrate.**’ (Specification at page 7, lines 23-24.) This statement does not say the substrate surface is absolutely not illuminated.”

As noted above in the additional rejection of the claims based under 35 USC 112(1), if Applicant asserts that somehow the substrate may be illuminated indirectly, then the specification does not provide enabling support for “without directly exposing the substrate to the light source” as presently claimed, since the specification only states the above that it is “not necessary...to illuminate the substrate.” There is simply no support for indirectly illuminating the substrate as Applicant alleges.

Beginning on p. 16, Applicant addresses the objection to the drawings. The objection stands because enablement is lacking. One of ordinary skill cannot practice the invention and would not know how to illuminate the ultra-narrow reaction volume above the substrate that is on the order of the thickness of a wavelength of light.

Beginning on p. 17, Applicant addresses the rejection of the claims under 35 USC 103(a). Applicant argues,

“Applicant respectfully suggests the extensive prosecution history of this application, and the seemingly incessant cycle of the Office asserting references and then withdrawn them, is proof that no prima facie case of unpatentability has even been made.”

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Examiner respectfully but emphatically disagrees. Examiner notes with special interest that **Applicant has amended the claims each of nine times** --that is each amendment, including the most recent amendment. In other words, the claimed invention has changed **nine** times. There can be no validity to Applicant's statement since Applicant has created the situation by amending the claims repeatedly and added new claims repeatedly, thereby requiring the application of additional prior art. Moreover, Examiner respectfully submits that any assertion of reference being cyclically applied and withdrawn has been the results of Applicant narrowing and then re-broadening the claims. For example, Applicant is presently arguing, as just noted, that "without directly exposing the substrate to the light source" is somehow enabled by a passage from the specification that it is "not necessary...to illuminate the substrate" but that somehow means that the substrate may still somehow be indirectly illuminated. Is the substrate illuminated or isn't it? Accordingly, it is Applicant who continues to change the nature of the claimed invention --not the Office.

Applicant argues that the rejection under 35 USC 103(a) is invalid because of the rejection of the claims under 35 USC 112(1) "begins with fundamentally incorrect first principles." The principles are correct as the evidence of record, (i.e. Bowen, Ohring, and the excerpt from the basic textbook Chemical Principles) demonstrates. Rather, Applicant has failed to provide anything but conclusory observation as to how the principles are flawed. MPEP 2145 states that "argument does not replace evidence where evidence is necessary." Applicant is invited to provide evidence.

Applicant's assertion that the inherency is improper is respectfully submitted to be in error. Applicant has not applied the case law to the instant facts but has instead merely listed the

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case law. The portion of the rejection based upon inherency is believed to be valid for reasons of record, as stated above in the rejection of the claims and included herein in its entirety but omitted for brevity.

Applicant asserts that the combination of references lacks motivation. Examiner respectfully disagrees for the reasons indicated in the rejection of the claims, above, and included herein in its entirety but omitted for brevity.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
Primary Examiner
September 8, 2003